No. 776,438. PATENTED NOV. 29, 1904.

J. THODE, DEC'D.

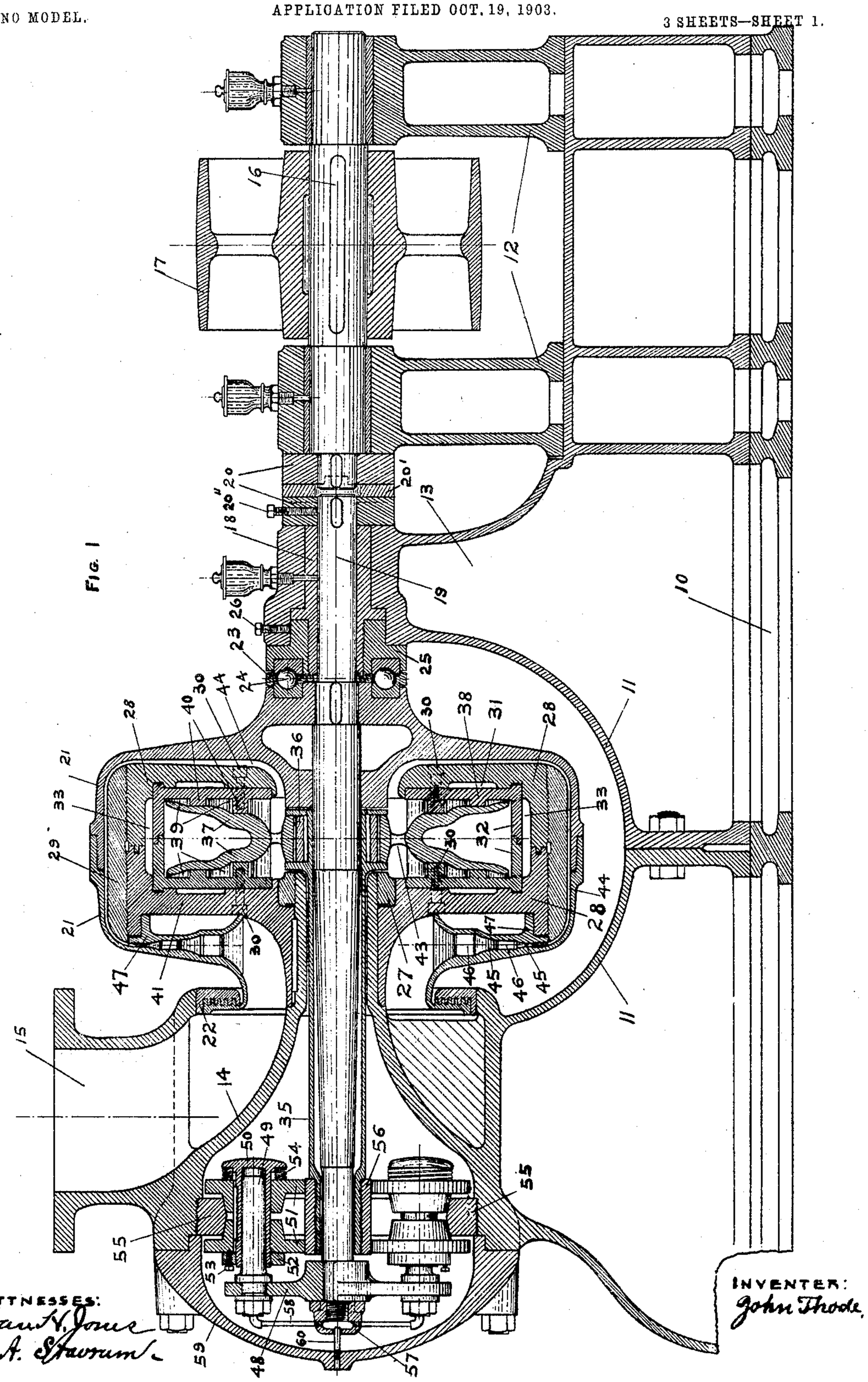
W. THODE, ADMINISTRATOR.

ROTARY ENGINE.

APPLICATION FILED OCT. 19, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

FIG. 1



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NO MODEL. 3 SHEETS—SHEET 2.

FIG. 2

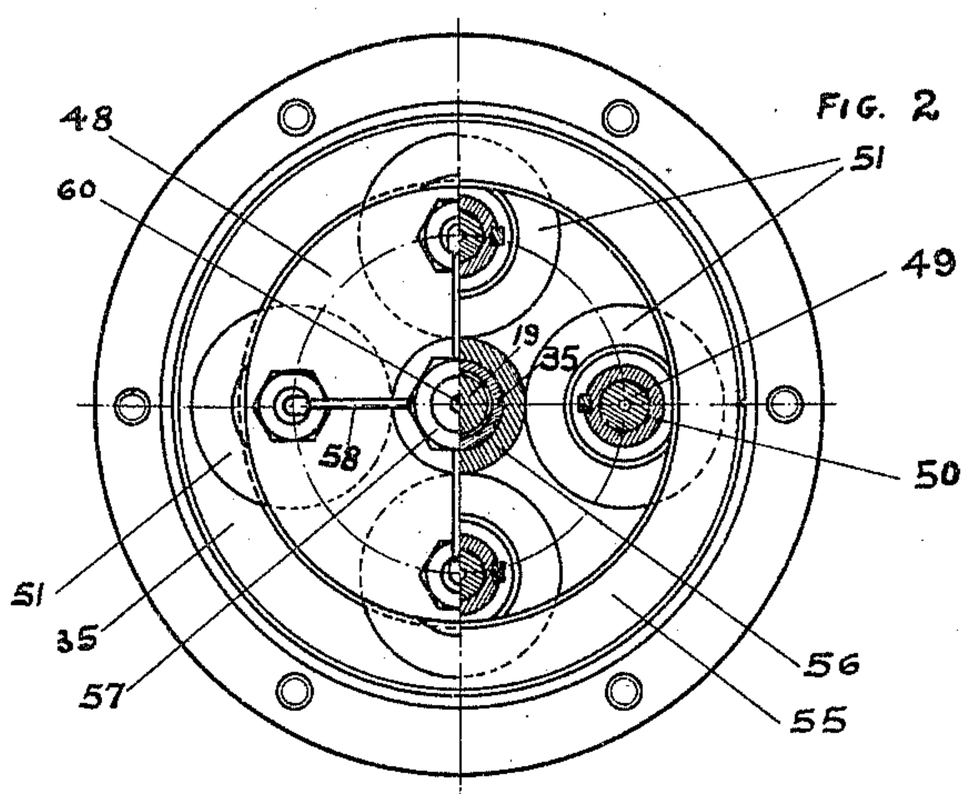
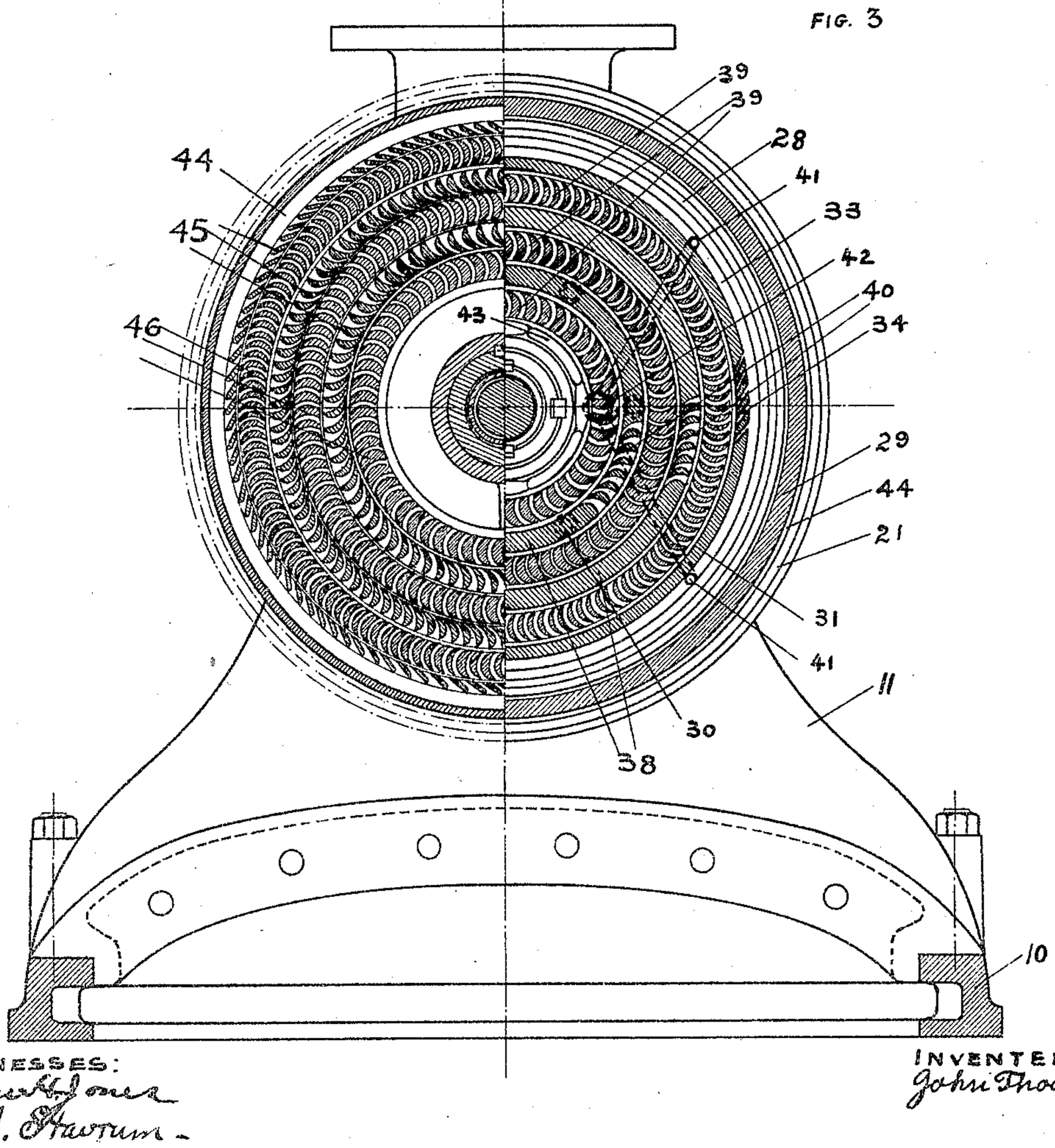


FIG. 3



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NO MODEL. 3 SHEETS—SHEET 3.

FIG. 5

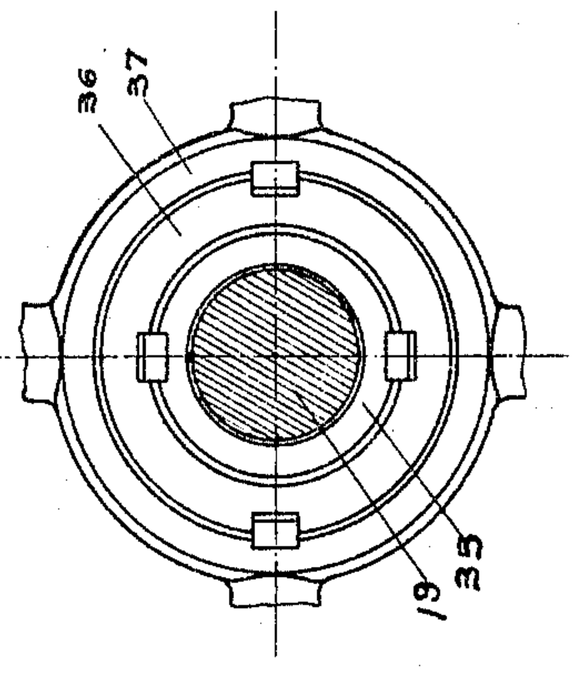
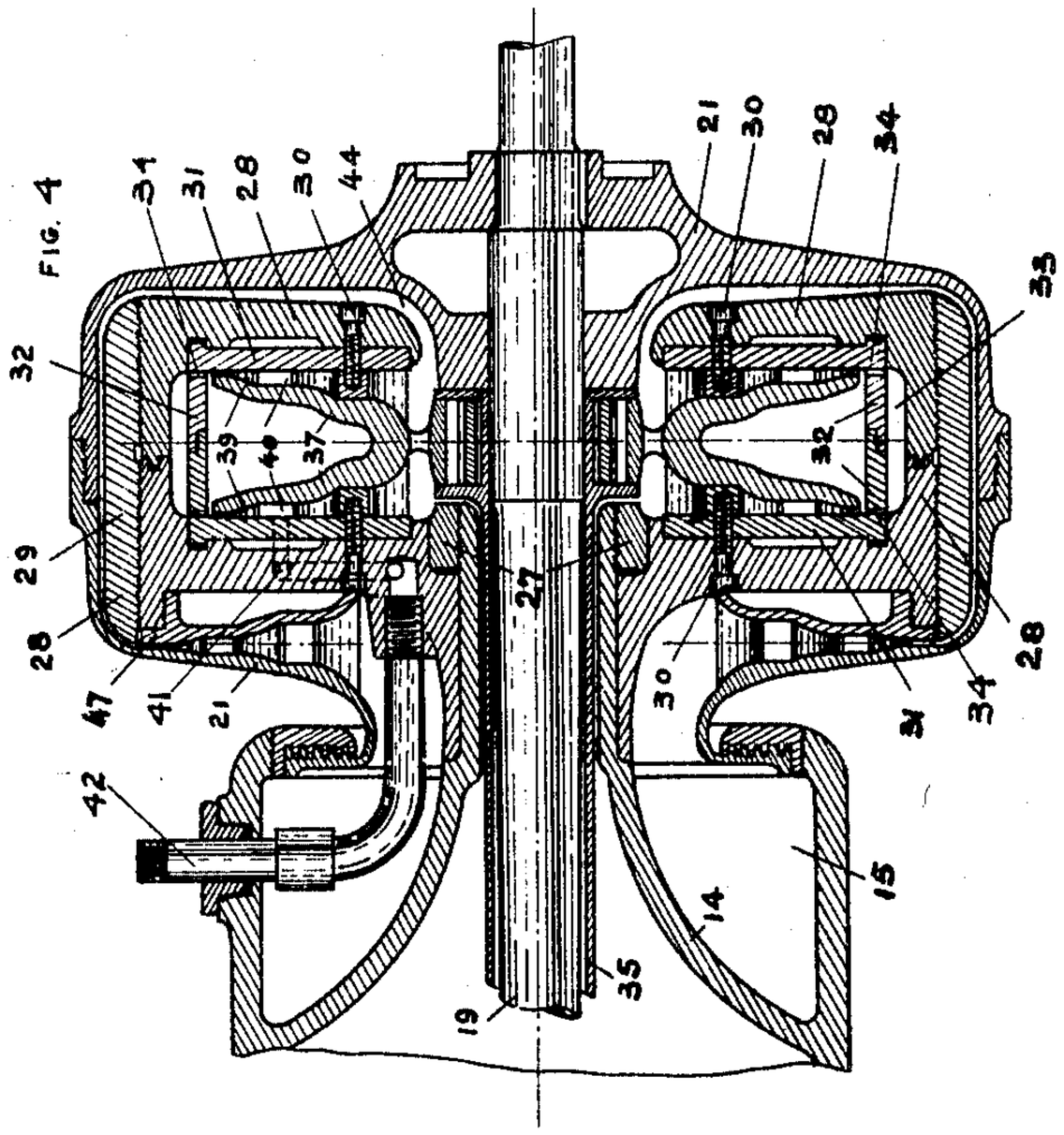


FIG. 4



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No. 776,438. Patented November 29, 1904.

UNITED STATES PATENT OFFICE.

JOHN THODE, OF MILWAUKEE, WISCONSIN; WILLIAM THODE ADMINISTRATOR OF SAID JOHN THODE, DECEASED.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 776,438, dated November 29, 1904.

Application filed October 19, 1903. Serial No. 177,518. (No model.)

To all whom it may concern:

Be it known that I, JOHN THODE, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a new and useful Improvement in Rotary Engines, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

My invention relates to new and useful improvements in rotary engines, and particularly those of the turbine or impact type, and has for its object to improve upon the general construction and arrangement of such engines.

A further object is to utilize in such an engine the expansive force of steam which has done part of its work and add its effect to the work initially done.

Another object is to make use of the heat given off to the frame by the live steam during expansion to revive the partially-exhausted steam preparatory to a second expansion of said steam.

An object of this invention is also to turn the drive-shaft at a reduced speed and to dispense with all steam-tight packing thereon.

With the above objects in view the invention consists of the devices and parts or their equivalents, as hereinafter set forth.

In the accompanying drawings, in which like characters of reference indicate same parts in the several views, Figure 1 is a central longitudinal vertical section of an engine embodying improvements in accordance with my invention. Fig. 2 is an end elevation of the planetary gearing, the right half thereof being sectioned between the rollers. Fig. 3 is a transverse section of the engine, the right half thereof being taken on a plane through a high-speed turbine and the left half being taken on a plane through the low-speed turbine. Fig. 4 is a horizontal section of the turbine parts, and Fig. 5 is an enlarged view of the means for mounting the turbine-wheel.

In the drawings, 10 represents a bed or base having mounted thereon a frame 11, formed in two sections securely fastened together, one being provided with a table on which are mounted standards 12 and also being provided with an integral pillow-block 13. The other section of the frame 11 is provided with an integral funnel-shaped gear-casing 14, having its smaller end or neck extending in the direction of the pillow-block and standards and being surrounded by an exhaust passage-way 15. A shaft 16 is journaled in suitable bearings in the standards 12 and has fixed thereon a belt-pulley 17, the shaft being preferably prevented from longitudinal movement by opposite shoulders thereon engaging the bushings of the bearings.

Journaled in a removable bushing 18, carried by the pillow-block 13, is a shaft 19, having one of its ends connected to an end of the shaft 16 by a shaft-coupling comprising collars 20, keyed on the ends of the respective shafts, and an interposed clutch-ring 20′, having radial flanges on its opposite sides fitting in corresponding grooves of the collars 20, whereby any side pressure of the shaft 16 due to the pull of the belt on pulley 17 is not transmitted to the shaft 19. A set-screw 20″ is threaded in the collar 20 of shaft 19 to prevent movement of the said collar on the shaft.

The shaft 19 has rigidly mounted on its intermediate portion a turbine-shell 21, which is formed in two sections threaded together, the one having a flanged end slidable in a ring 22 in the mouth of the exhaust passage-way 15 and having a gas-tight connection therewith in the nature of intermeshing annular flanges, which permit of the turning of said turbine-shell. The other section of the turbine-shell at its hub is provided with a roller thrust-bearing 23, comprising the raceway between said hub, and a collar 25, threaded on the bushing 18, in which raceway travel anti-friction-balls 24.

The collar 25 being threaded on the bushing 18 is adapted to slightly adjust the shaft 19 and turbine-shell 21 toward or away from the gear-casing 14 for the purpose of properly adjusting the turbine-blades, and this adjustment may be provided for by turning in or out the ring 22, which is threaded in the frame. When the adjustment is accomplished, the collar 25 is locked in place by a set-screw 26.

Within the turbine-shell 21 a turbine-frame

28 is rigidly secured to the projecting neck of the funnel-shaped gear-casing 14 by being keyed thereon and held against a shoulder of the gear-casing 14 by a collar 27, threaded on the neck of said casing 14. The turbine-frame 28 is also formed in two sections, with a gas-tight tongue-and-groove connection between them, and said sections are bound together by an external band-ring 29, threaded to both of them with threads of different pitch, so that the sections may be clamped together thereby. Each section of the turbine-frame has fitted within it and fastened thereto by any suitable means, such as screws 30, one section of the turbine-frame lining 31, which sections have joined outer flanges 32, forming between them and the inner walls of the frame-sections an annular live-steam space 33 and having at the sides of the frame groups of inclined inlet-perforations 34.

A sleeve 35 is loosely mounted on shaft 19 and has keyed to it near its end a ring 36, which is capable of radial movement on its keys, and similarly keyed to said ring, with its keys in a plane at right angles to the first-mentioned keys, is a turbine-wheel 37, with its pair of diverging disks contained within the walls of the turbine-frame lining 31.

The walls of the turbine-frame lining 31 have their inner surfaces provided with inwardly-projecting stepped annular concentric flanges 38, and the outer surfaces of the turbine-wheel disks are provided with annular series of crescent-shaped blades 39, fitting between the said flanges 38. As clearly seen in the right-hand section of Fig. 3, the flanges 38 are provided with groups of curved converging perforations 40 at the sides of the frame corresponding to the groups of inclined inlet-perforations 34; but the groups of perforations of each flange being slightly in advance in the direction of rotation of the turbine-wheel to those of the outer flange next thereto.

Live steam, preferably superheated, is admitted to the live-steam space 33 by means of the passage-ways 41 in the turbine-frame, which are fed by means of the steam-pipe 42, connected therewith at the side of the frame from some external source of steam-supply. The steam passing through the inlet-perforations 34 impinges upon the first series of blades 39 and passes therefrom to the first series of perforations 40, and then by the succeeding blades and perforations to the innermost space between the turbine-frame lining 31 and the turbine-wheel 37. Openings 43 connect these innermost spaces so the steam on one side may pass through to the other side, and a passage-space 44 is left between the turbine-shell 21 and the turbine-frame 28, so the steam may pass from one of said innermost spaces entirely around the turbine-frame 28 in a thin film. On the other side of the turbine-frame 28 is rigidly secured a turbine-disk 47, preferably threaded to a flange of the turbine-frame, and said turbine-disk has on its outer face concentric annular perforated flanges 45, fitting between annular series of crescent-shaped blades 46 on the interior of the turbine-shell 21.

From the foregoing it is clear that steam being admitted by the steam-pipe 42 to the live-steam space 33 through passage-ways 41 will pass with great force through the series of inclined inlet-perforations 34 in the flanges of the turbine-frame lining 31 to the two spaces between the turbine-wheel 37 and the said turbine-frame lining 31, where it will cause said turbine-wheel to rapidly rotate by successively impinging upon the several series of blades 39 carried thereby until on reaching the innermost spaces the partially-expanded steam from both sides unites through openings 43. Steam then passes in a thin film in all directions through the passage 44 around the turbine-frame 38 to the secondary turbine arrangement between the turbine-disk 47 and the turbine-shell 21, where its further expansion causes said turbine-shell to rotate in the same direction as the turbine-wheel 37, but at a lower speed, and finally passes out through the exhaust passage-way 15.

The two rotating bodies—the turbine-wheel 37 and the turbine-shell 21—are to be coupled together by a means allowing for their different speeds, so the power of both may be taken from the single pulley 17. This I accomplish by rigidly securing on the end of shaft 19 a disk 48, carrying a number of laterally-extending tubular spindles 49, on which are mounted headed bushings or thimbles 50, each carrying a pair of double-tread rollers 51, splined to said thimble 50, the one being secured by a lock-nut 52, threaded on the bushing, with a set-screw 53, engaging said roller. The other roller is normally pressed toward the fixed roller by a coil-spring 54 bearing thereon and also bearing on the head of bushing or thimble 50. The smaller or inner treads of the pairs of rollers 51 are tapered and tightly bear upon the angular inner bearing-surface of a friction ring or track 55, rigidly secured within the funnel-shaped gear-casing 14, so that during the rotation of shaft 19 the said pairs of rollers 51 ride upon the bearing-surface of the friction-ring 55. The outer or larger treads of the rollers 51 frictionally engage a friction-sleeve 56, rigidly mounted on the end of sleeve 35, so that the rotation of the said sleeve is also imparted to the rollers 51, and an epicyclic train of friction-gearing is formed with the friction-ring 55 as the fixed member and the rollers 51 turning thereon as the planetary members rotating the shaft 19 at a different speed from sleeve 35, and the proportions of these parts are made such that the ratio of speed between the turbine-wheel and the turbine-shell is maintained.

A cavity-nut 57 is employed to secure disk

48 to shaft 19, and from the cavity thereof radial tubes 58 lead to the bores of the tubular spindles 48, so that oil may be fed from said cavity through the tubes 58 to the interior of the bushings or thimbles 50. A cap 59 is seated over the end of the funnel-shaped gear-casing 14 and has a tube 60 connected with any suitable lubricant-supply under pressure on the outside, and said tube projects within an opening of the nut 57 to the cavity thereof.

With an engine of the construction set forth it is possible to produce two different expansions of the steam and combine the effects produced thereby and at the same time utilize the waste heat given off by the first expansion of the steam to reheat the thin film of partially-exhausted steam surrounding the turbine-frame, and thereby increase its pressure, and consequently augment the power of the engine.

The loose keyed-ring connection 36 between the turbine-wheel 37 and the sleeve 35 enables a slight free radial movement of the turbine-wheel in any direction, so that it may find its own center of gravity when rotated at a high speed, the play between the flanges and series of blades being sufficient to permit this.

What I claim as my invention is—

1. In a rotary engine, a shaft, a turbine-wheel mounted thereon having a pair of active faces, rings of blades on the active faces of the turbine-wheel, an immovable turbine-frame surrounding the turbine-wheel and provided with an annular steam-space with perforations leading from said steam-space to the active faces of the turbine-wheel, and concentric annular flanges on the turbine-frame fitting between the rings of blades of the turbine-wheel and provided with perforations, said turbine-wheel being provided with a passage near its hub through which the steam may pass from one side thereof to the other, and said turbine-frame having an exhaust-passage communicating with said passage.

2. In a rotary engine, a shaft, a turbine-wheel mounted thereon having a pair of active faces, concentric rings of blades on the active faces of the turbine-wheel, an immovable turbine-frame surrounding the turbine-wheel, a turbine-frame lining rigidly secured within the turbine-frame and producing between it and the turbine-frame an annular steam-space, concentric annular flanges on the inside of the turbine-frame lining, said flanges and the turbine-frame lining having perforations, the rings of blades on the active faces of the turbine-wheel fitting between the flanges of the turbine-frame lining, and means for conducting steam from the spaces between the turbine-wheel and the turbine-frame lining.

3. In a rotary engine, a shaft, a turbine-wheel mounted thereon having a pair of active faces, concentric rings of blades on the active faces of the turbine-wheel, an immovable turbine-frame surrounding the turbine-wheel and provided with an annular steam-space with perforations leading from said steam-space to the active faces of the turbine-wheel, concentric flanges on the turbine-frame fitting between the rings of blades on the turbine-wheel and provided with perforations, said turbine-wheel being provided with a passage near its hub through which the steam may pass from one side thereof to the other, and a turbine-shell surrounding the turbine-frame and providing therebetween an exhaust-passage around the turbine-frame in communication with the passage through the turbine-wheel.

4. In a rotary engine, a shaft, a turbine-wheel mounted theron having a pair of active faces, concentric rings of blades on the active faces of the turbine-wheel, an immovable turbine-frame surrounding the turbine-wheel and formed in sections, a band-ring joining the sections of the turbine-frame, a turbine-frame lining also formed in sections and secured within the sections of the turbine-frame, producing between it and the turbine-frame an annular steam-space and having inclined perforations leading from said steam-space to the interior of the lining, concentric flanges on the inner walls of the turbine-frame lining fitting between the concentric rings of blades on the turbine-wheel, said turbine-wheel having a passage connecting its two active faces, and means for conducting the exhaust-steam from said passage.

5. In a rotary engine, a shaft, a turbine-wheel mounted thereon having a pair of active faces, concentric rings of blades on the active faces of the turbine-wheel, an immovable turbine-frame surrounding the turbine-wheel and formed in sections, a band-ring joining the sections of the turbine-frame, a turbine-frame lining also formed in sections and secured within the sections of the turbine-frame, producing between it and the turbine-frame an annular steam-space and having inclined perforations leading from said steam-space, to the interior of the lining, concentric flanges on the inner walls of the turbine-frame lining fitting between the concentric rings of blades of the turbine-wheel, said turbine-wheel having a passage connecting its two active faces, a turbine-shell surrounding the turbine-frame with a space therebetween forming a passage-way for the partially-expanded steam leading from the passage through the turbine-wheel and around the turbine-frame, a series of concentric flanges having perforations on the exterior of the turbine-casing, concentric rings of blades on the interior of the turbine-shell fitting therebetween, and an exhaust-passage leading from said turbine-shell.

6. In a rotary engine, a shaft, a turbine-wheel mounted thereon having a pair of active faces, concentric rings of blades on the active faces of the turbine-wheel, an immovable tur-

bine-frame surrounding the turbine-wheel and formed in sections, a band-ring joining the sections of the turbine-wheel, a turbine-frame lining also formed in sections and secured within the sections of the turbine-frame producing between it and the turbine-frame an annular steam-space and having inclined perforations leading from said steam-space to the interior of the lining, concentric flanges on the inner walls of the turbine-frame lining fitting between the concentric rings of blades on the turbine-wheel, said turbine-wheel having a passage connecting its two active faces, a turbine-shell surrounding the turbine-frame with a space therebetween forming a passage-way for the partially-expanded steam leading from the passage through the turbine-wheel and around the turbine-frame, a series of concentric flanges having perforations on the exterior of the turbine-casing, concentric rings of blades on the interior of the turbine-shell fitting therebetween, said turbine-shell being formed in sections, and a stationary exhaust passage-way having a steam-tight connection with the turbine-shell.

7. In a rotary engine, a shaft, a turbine-wheel loosely mounted thereon, an immovable turbine-frame surrounding the turbine-wheel, a turbine-shell mounted on the shaft and surrounding the turbine-frame with a passage-way therebetween leading from the interior of the turbine-frame, and interfitting concentric perforated annular flanges and rings of blades on the exterior of the turbine-frame and the interior of the turbine-shell.

8. In a rotary engine, a shaft, a turbine-wheel loosely mounted thereon, an immovable turbine-frame surrounding the turbine-wheel, a turbine-shell mounted on the shaft and surrounding the turbine-frame with a passage-way therebetween leading from the interior of the turbine-frame, a disk secured to the exterior of the turbine-frame, a series of concentric perforated annular flanges projecting therefrom, and concentric rings of blades on the interior of the turbine-shell fitting between the flanges of the disk.

9. In a rotary engine, a shaft, a turbine-wheel loosely mounted thereon, an immovable turbine-frame surrounding the turbine-wheel, a turbine-shell mounted on the shaft and surrounding the turbine-frame with a passage-way therebetween leading from the interior of the turbine-frame, interfitting concentric perforated annular flanges and rings of blades on the exterior of the turbine-frame and the interior of the turbine-shell, and means for gearing together the shaft and the turbine-wheel.

10. In a rotary engine, a shaft, a sleeve loosely mounted on the shaft, a turbine-wheel carried by the sleeve, an immovable turbine-frame surrounding the turbine-wheel, a turbine-shell mounted on the shaft and surrounding the turbine-frame with a passage-way therebetween leading from the interior of the turbine-frame, interfitting concentric perforated annular flanges and rings of blades on the exterior of the turbine-frame and the interior of the turbine-shell, and a planetary gearing connecting the shaft and the turbine-wheel.

11. In a rotary engine; a shaft; a sleeve loosely mounted on the shaft; a turbine-wheel and a turbine-shell, one of which is connected with the shaft and the other is connected to the sleeve; a turbine-frame having active relation with the turbine-wheel and the turbine-shell; and a planetary gearing connecting the sleeve and the shaft.

12. In a rotary engine, a shaft, a sleeve loosely mounted on the shaft, a turbine-wheel carried by the sleeve, a turbine-shell carried by the shaft, a stationary turbine-frame contained within the turbine-shell and inclosing the turbine-wheel, said turbine-frame having an active relation with the turbine-wheel and the turbine-shell, and a planetary gearing connecting the sleeve and the shaft.

13. In a rotary engine, a shaft, a sleeve loosely mounted on the shaft, a turbine-wheel carried by the sleeve, a turbine-shell carried by the shaft, a stationary turbine-frame contained within the turbine-shell and inclosing the turbine-wheel, said turbine-frame having an active relation with the turbine-wheel and the turbine-shell and means for gearing the shaft and sleeve together.

14. In a rotary engine, a shaft, a sleeve loosely mounted on the shaft, a turbine-wheel carried by the sleeve, a turbine-shell carried by the shaft, a stationary turbine-frame contained within the turbine-shell and inclosing the turbine-wheel, said turbine-frame having an active relation with the turbine-wheel and the turbine-shell, and means for deriving motion from the shaft and the sleeve.

15. In a rotary engine, a shaft, a sleeve loosely mounted on the shaft, a turbine-wheel carried by the sleeve, a turbine-shell carried by the shaft, a stationary turbine-frame contained within the turbine-shell and inclosing the turbine-wheel, said turbine-frame having an active relation with the turbine-wheel and the turbine-shell, a pulley driven by the shaft, and means connecting the shaft and the sleeve whereby their combined force may be imparted to the pulley.

16. In a rotary engine, a shaft, a sleeve loosely mounted on the shaft, a turbine-wheel carried by the sleeve, a turbine-shell carried by the shaft, a stationary turbine-frame contained within the turbine-shell and inclosing the turbine-wheel, said turbine-frame having an active relation with the turbine-wheel and the turbine-shell, means driven by the shaft, and a connection between the sleeve and the shaft whereby the energy of the sleeve is imparted to the shaft to augment the energy of the shaft.

17. In a rotary engine, a shaft, a sleeve loosely mounted on the shaft, a turbine-wheel carried by the sleeve, a turbine-shell carried by the shaft, a stationary turbine-frame contained within the turbine-shell and inclosing the turbine-wheel, said turbine-frame having an active relation with the turbine-wheel and the turbine-shell, a gear-casing into which the shaft and sleeve extend, and differential gearing in the gear-casing connecting the sleeve with the shaft whereby the speed of the sleeve is equalized with that of the shaft and imparted to said shaft.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN THODE.

Witnesses:
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